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Characterisation of the Palaeoproterozoic mantle beneath southeastern Sweden: Geochemistry and isotope geochemistry (Nd, Sr) of mafic plutonic rocks in the Transscandinavian Igneous Belt

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Geochemistry and isotope geochemistry of c. 1.80 Ga, undeformed mafic intrusions of the Transscandinavian Igneous Belt (TIB-1) in the Fennoscandian shield have been studied throughout its southernmost part in southeastern Sweden. The aims were to characterize the mantle sources from which the TIB-1 mafic magmas were extracted, the extent of crustal interaction, and to derive clues for interpretation of the plate tectonic environment.

89 samples were collected from 47 intrusions, and after field and microscopic studies 37 samples were analysed for geochemistry. 15 of these were selected for Sr and Nd isotopic analysis, based on geographical and geochemical diversity. None of the investigated intrusions have been dated, but because contact relations to the surrounding granitoids often show magma mingling-mixing relations, and there are frequent occurrences of mafic enclaves and synplutonic mafic dykes within the granitoids of this area, the mafic intrusions are considered coeval with the granitoids, with an age of c. 1.80 Ga.

Compositions vary from peridotitic to monzogabbroic. The SiO_2 contents of the intrusions vary between 39 and 54 wt%, and Mg# between 81 and 45, indicating considerable variation in evolutionary level. Ultrabasic rocks may be cumulitic; some rocks are enriched in plagioclase, while some of the most evolved rocks tend to be enriched in Fe, Ti and P. The signatures are predominantly calc-alkaline, LILE and

LREE enriched, of continental arc type. The ε_{Nd}(1.80) values are between 0 and +2, while $^{87}Sr/^{86}Sr$(1.80) values range between 0.7022 and 0.7033, where the most depleted compositions tend to be located in the south. There is no systematic correlation between chemical parameters and isotope ratios. However, a trend from 'mildly depleted' isotopic compositions of c. ε_{Nd}(1.80) = +2 and $^{87}Sr/^{86}Sr$(1.80) = 0.7022 to ε_{Nd}(1.80) = 0 and $^{87}Sr/^{86}Sr$(1.80) = 0.7033 is observed. As none of the samples had more depleted compositions, and published ε_{Nd}(1.80) values above +2 are rare for mafic rocks in the southern TIB (DM at 1.80 Ga = +3.9), such isotopically 'mildly depleted' mantle sources seem to be characteristic for the whole southern TIB. The spread towards slightly more enriched isotopic compositions, irrespective of chemical evolution, may be due to local crustal contamination or variations in the mantle source itself. It is important to note, however, that one reason for the limited isotopic range may be the rather juvenile nature of the associated crust; ε_{Nd}(1.80) values below –1.5 are unknown for the southern TIB. Hence, no Archaean components appear to be present in this part of the shield.

In conclusion, the mafic TIB-1 rocks in southern Sweden are characterized by LILE-LREE-enriched signatures with subduction-type, mainly calc-alkaline geochemistries, and were generated from isotopically mildly depleted mantle sources in a continental arc environment. These sources are inferred to represent depleted mantle wedge material that was subjected to fluid-induced enrichment during the immediately preceding (c. 1.86-1.82 Ga) arc subduction, and/or during the TIB-1 magmatism itself.